

(12) **United States Patent**  
**Hao et al.**

(10) **Patent No.:** **US 9,106,476 B2**  
(45) **Date of Patent:** **Aug. 11, 2015**

(54) **OPTIMIZING SELECTION OF A NETWORK FOR VIDEO STREAMING**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 174 days.

(21) Appl. No.: **13/267,945**

(22) Filed: **Oct. 7, 2011**

(65) **Prior Publication Data**

US 2013/0091239 A1 Apr. 11, 2013

(51) **Int. Cl.**  
**G06F 15/16** (2006.01)  
**H04L 29/06** (2006.01)  
**H04L 29/08** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **H04L 29/06326** (2013.01); **H04L 29/06** (2013.01); **H04L 29/06489** (2013.01); **H04L 29/08072** (2013.01)

(58) **Field of Classification Search**  
CPC ..... H04L 29/08072; H04L 29/06  
USPC ..... 709/217–231  
See application file for complete search history.

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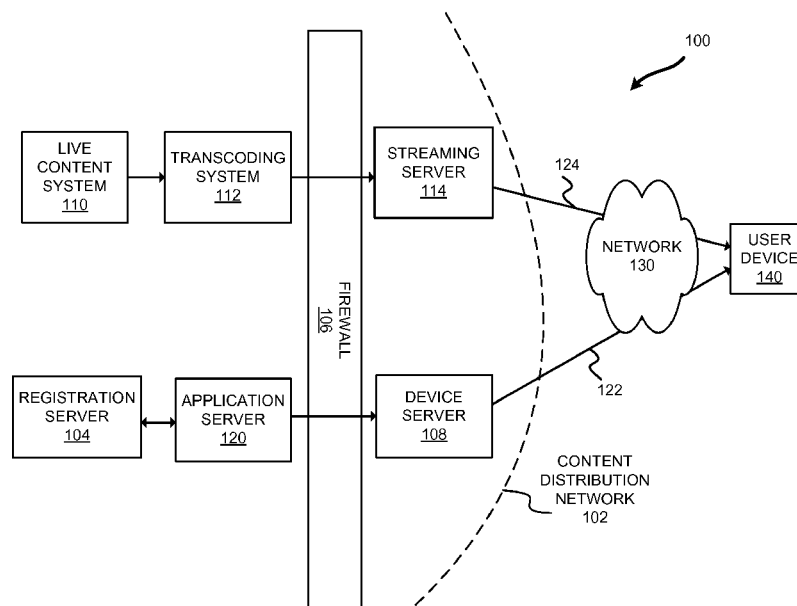
*Primary Examiner* — Chris Parry

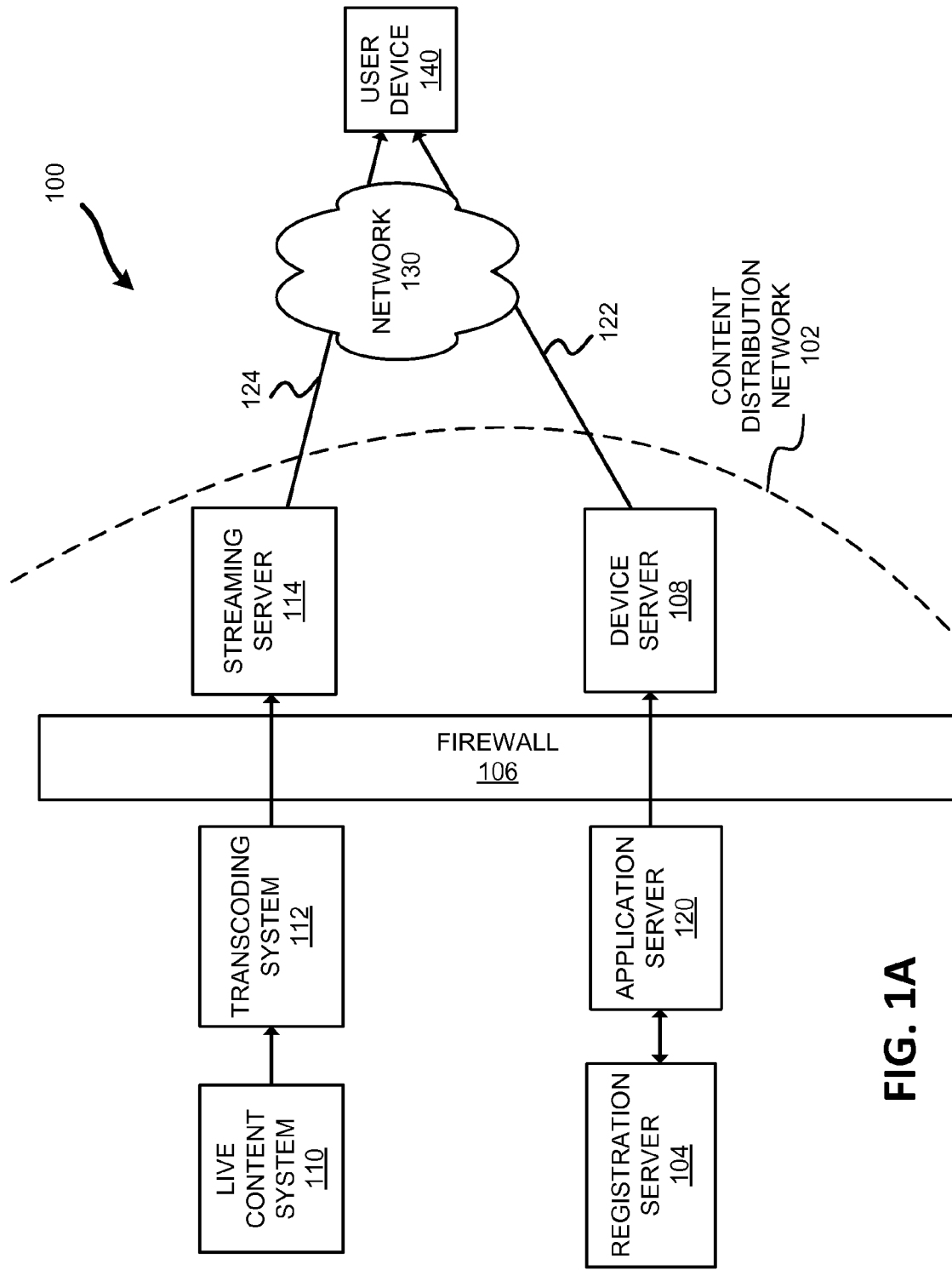
*Assistant Examiner* — Weiwei Stiltner

(57) **ABSTRACT**

A method includes receiving a request to provide streaming video content from a user device. A location is identified for the user device. Available networks to deliver the streaming video content are identified based on the location of the at least one user device. Network preference for delivery of the streaming video content is identified. The method also includes selecting an optimal network for delivering the streaming video content based on the location of the at least one user device, the available networks and the network preference for delivery of the streaming video content. The method may also include providing the streaming video content using the optimal network.

**19 Claims, 9 Drawing Sheets**





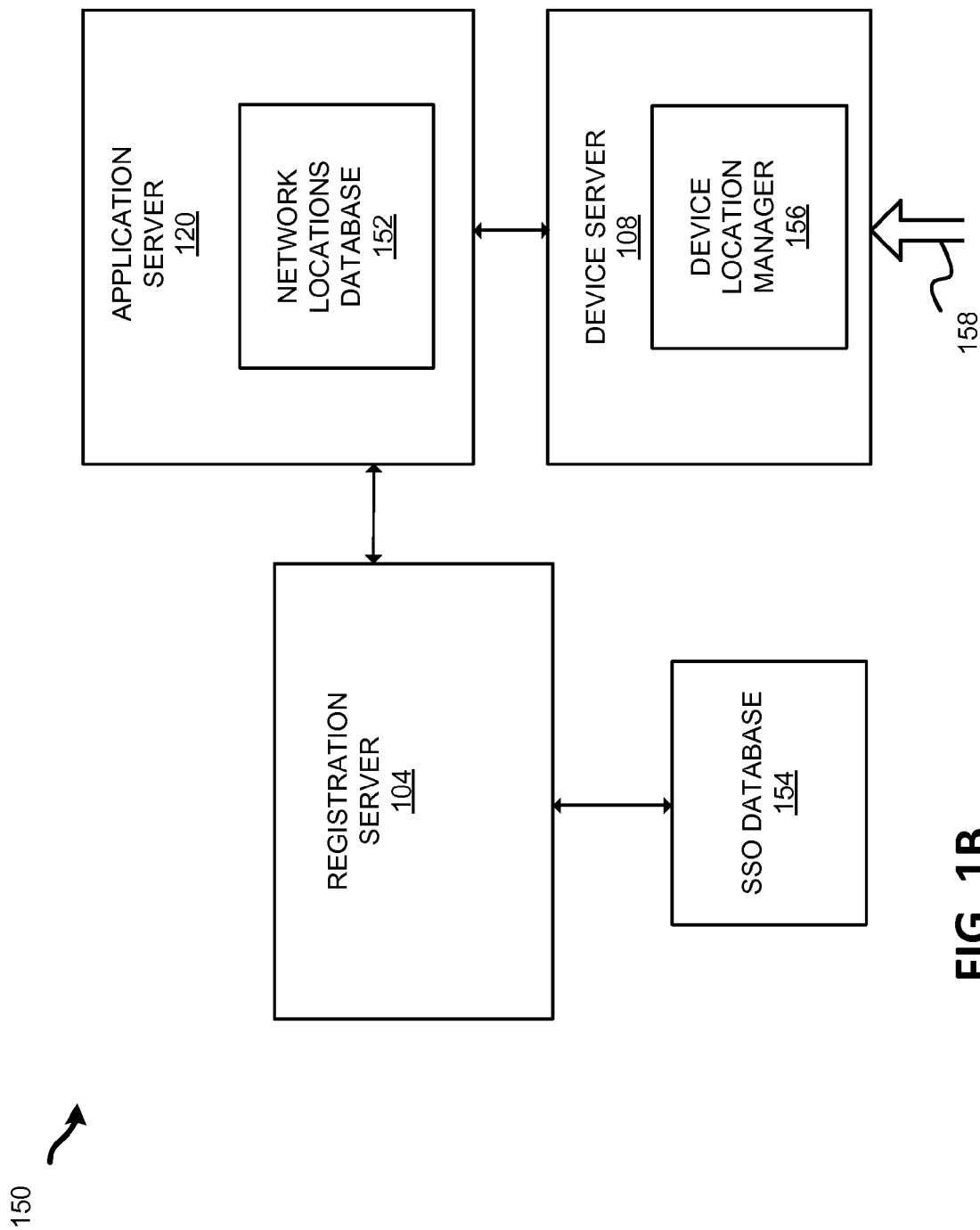


FIG. 1B

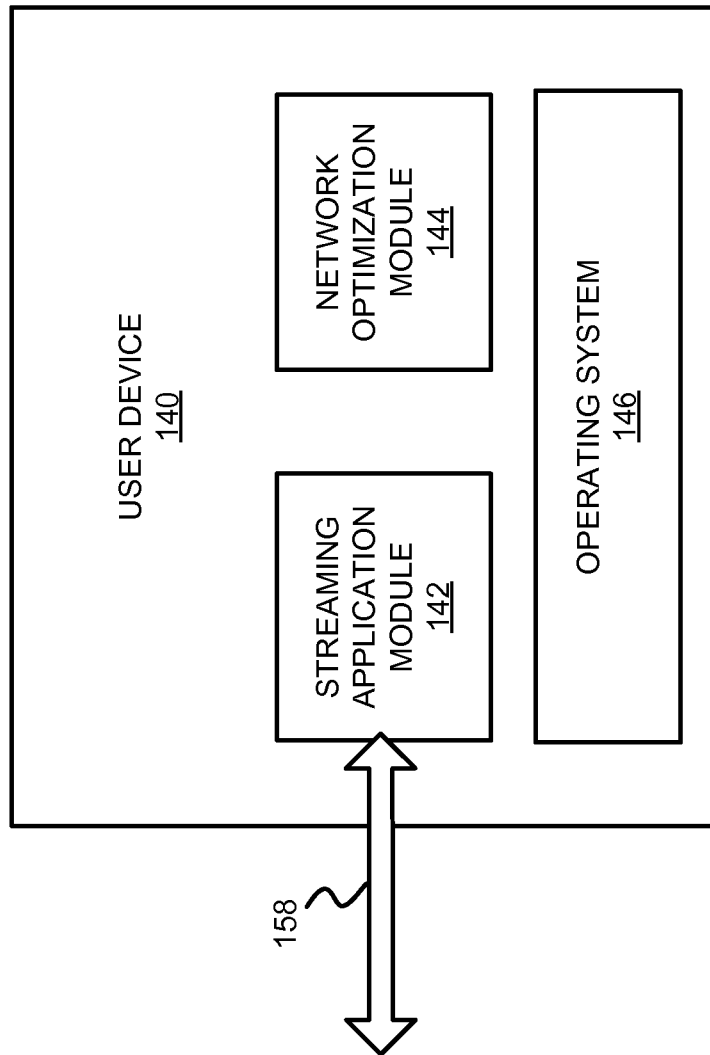
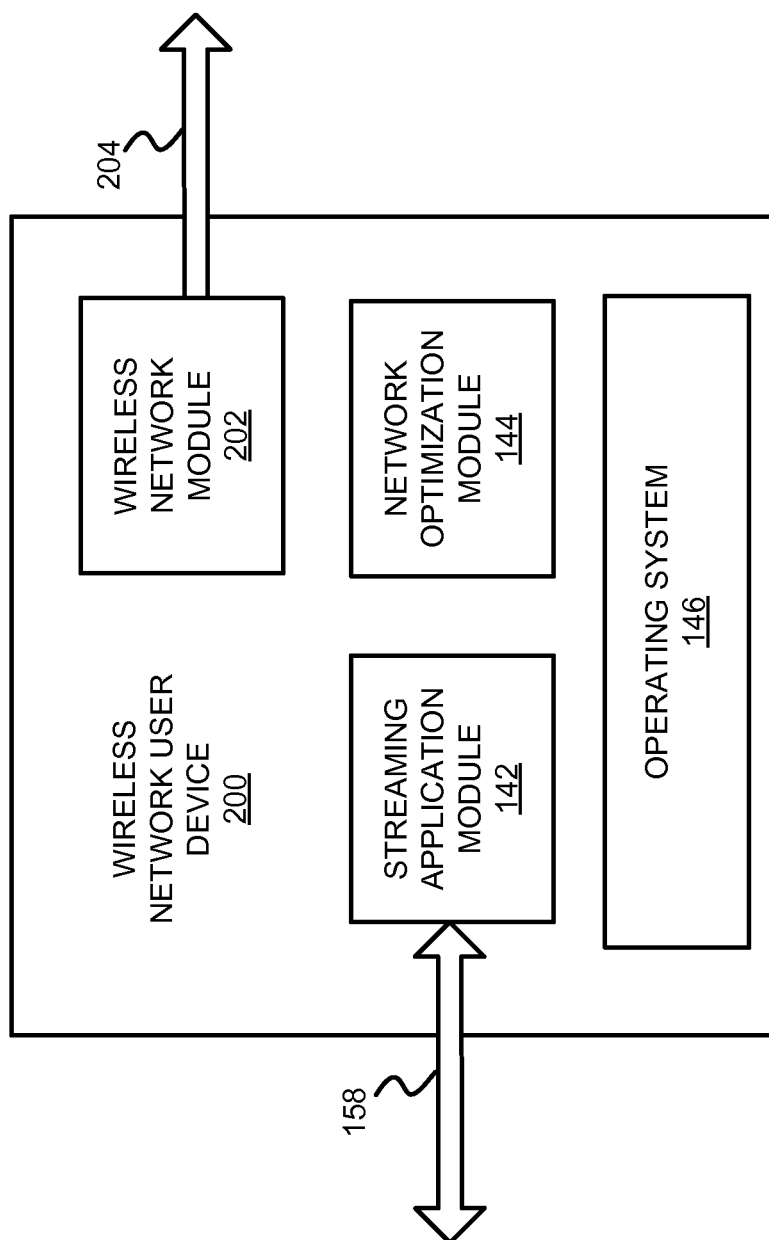


FIG. 2A



**FIG. 2B**

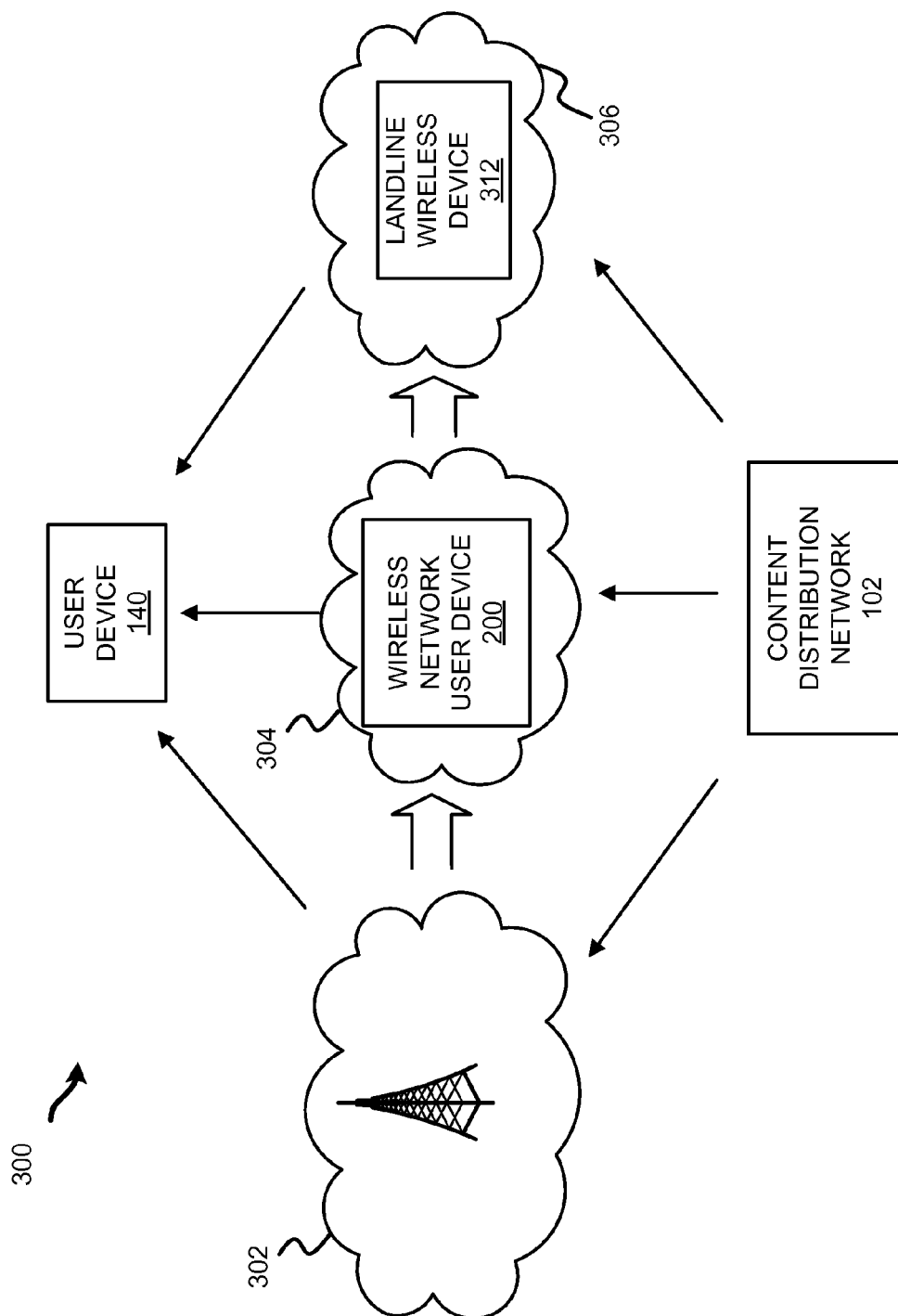


FIG. 3A

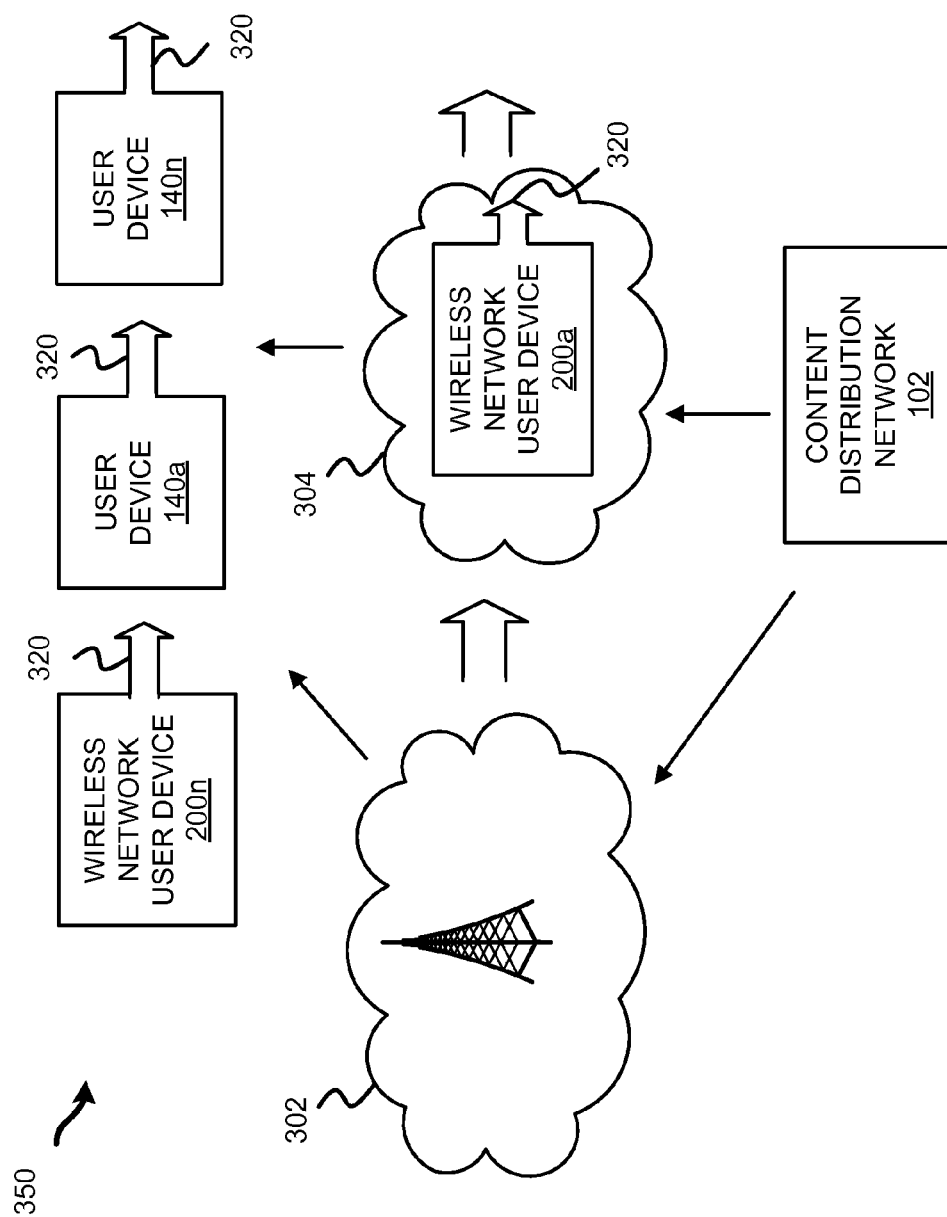


FIG. 3B

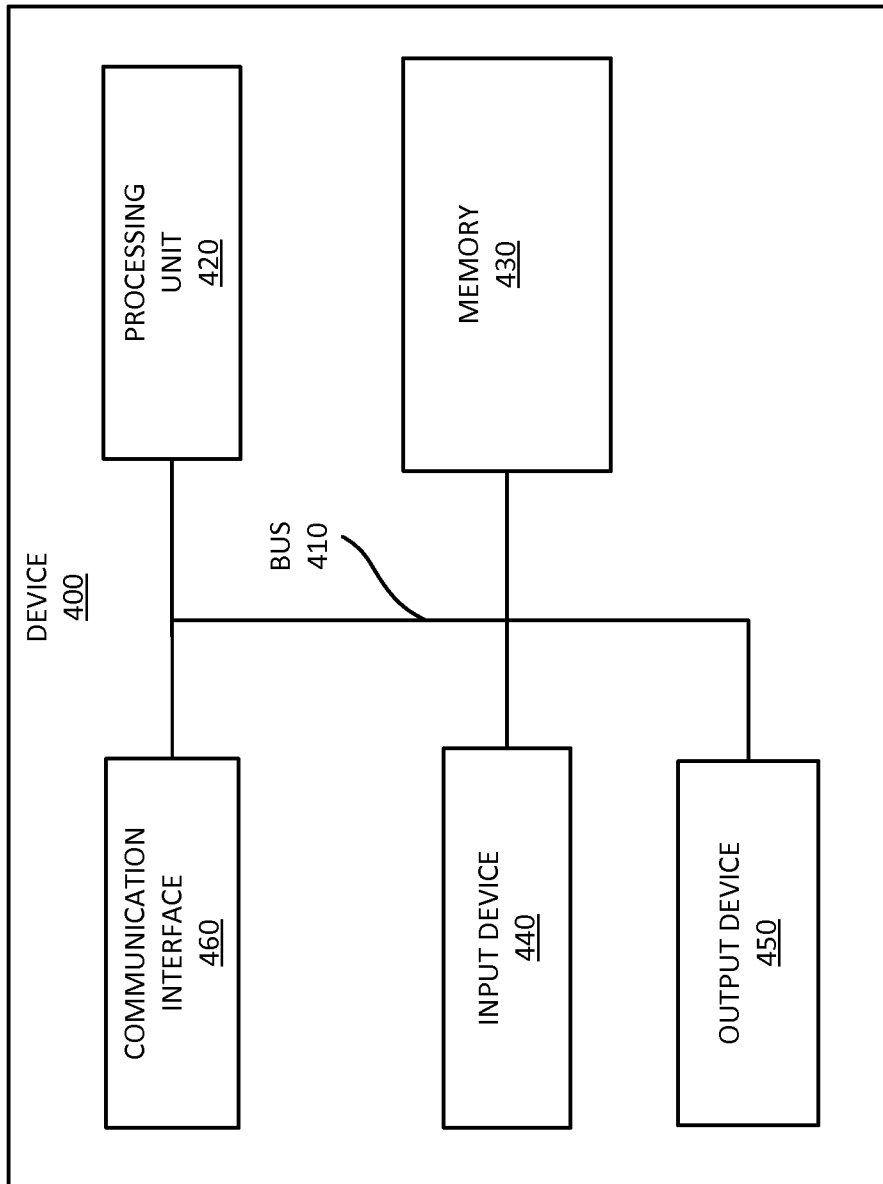
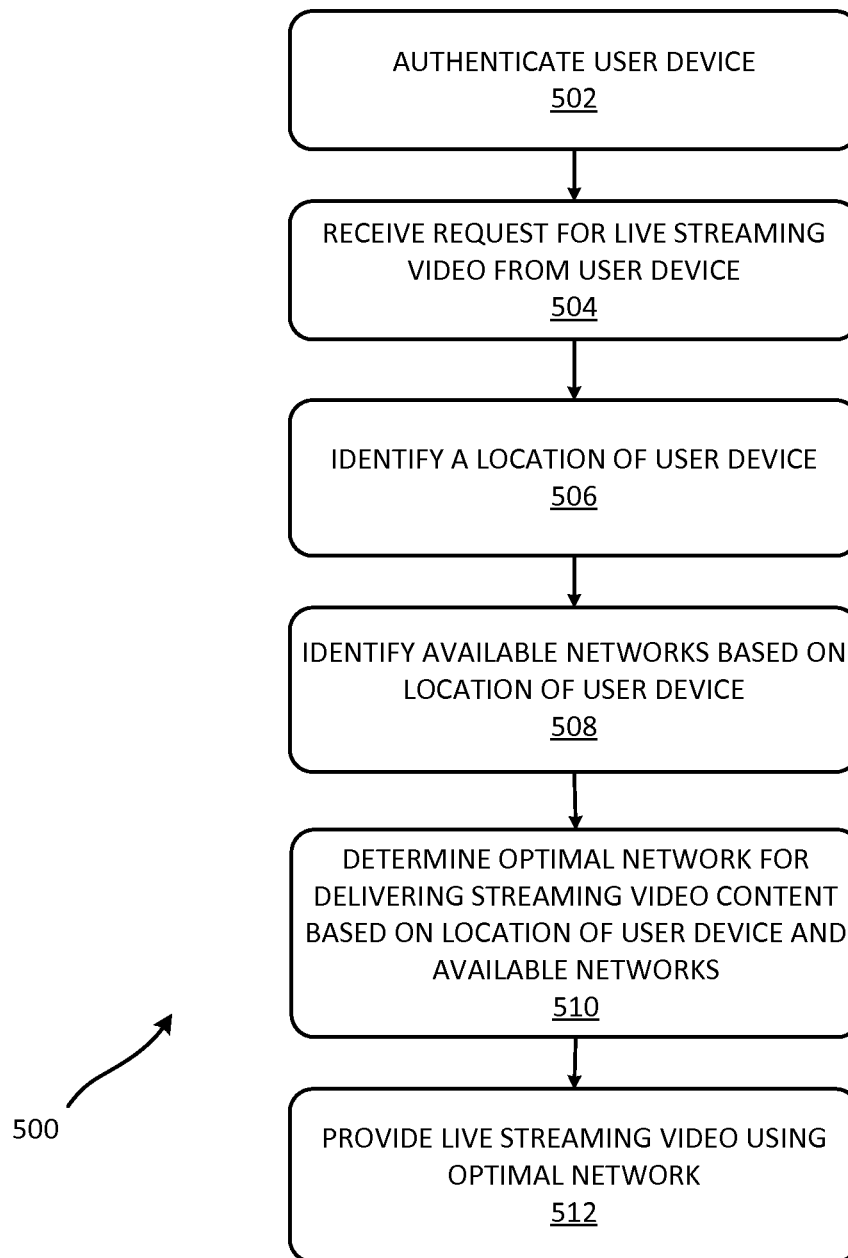
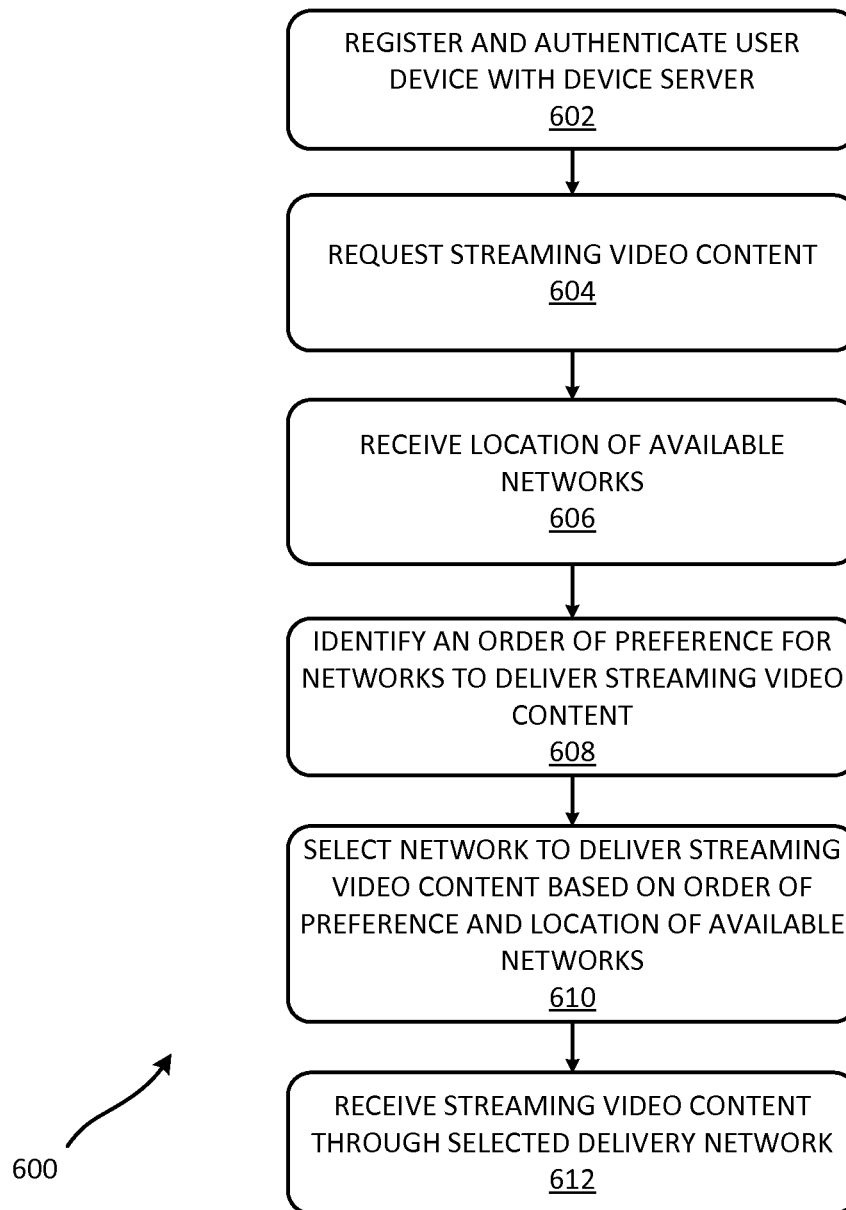


FIG. 4

**FIG. 5**

**FIG. 6**

## OPTIMIZING SELECTION OF A NETWORK FOR VIDEO STREAMING

### BACKGROUND INFORMATION

Video service providers currently provide multiple services, including live video, teleconferencing, cable television, and video chat services to their customers. In some instances, individual customers may receive combinations of these multiple services from a single video service provider. The video service providers may provide video services that may be accessed by customers using devices such as mobile telephones, personal computers, tablets, etc.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A illustrates an exemplary network in which systems and methods described herein may be implemented;

FIG. 1B illustrates a functional block diagram of a network delivery management system;

FIGS. 2A and 2B are functional block diagrams of exemplary user devices;

FIGS. 3A and 3B illustrate conceptual implementation of a process for optimizing selection of a network;

FIG. 4 illustrates an exemplary configuration of one or more of the components of FIG. 1A;

FIG. 5 is a flowchart of an exemplary process for selecting an optimal network for delivering streaming video content to a user device; and

FIG. 6 is another flowchart of an exemplary process for selecting an optimal network for delivering streaming video content to a user device.

### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The following detailed description refers to the accompanying drawings. The same reference numbers in different drawings may identify the same or similar elements. Also, the following detailed description is exemplary and explanatory only and is not restrictive of the invention, as claimed.

Embodiments described herein relate to devices, methods, and systems for selecting an optimal network for delivering streaming video content to a user device. Consistent with the embodiments described herein, an optimal network to deliver streaming video content to a user device may be determined based on an increasing order of preferences and available networks, such as from a mobile telecommunications network, such as a third generation mobile telecommunications (3G) or fourth generation mobile telecommunications (4G) network, a mobile wireless network or a landline wireless network.

FIG. 1A is a diagram of an exemplary network 100 in which systems and/or methods described herein may be implemented. As illustrated, network 100 may include a content distribution network 102 and a user device 140. Content distribution network 102 may include a registration server 104, an application server 120, a device server 108, a live content system 110, a transcoding system 112 and a streaming server 114. Content distribution network 102 and user device 140 may be interconnected by network 130. Components of network 100 may be interconnected via wired and/or wireless connections. The configuration of components of network 100 illustrated in FIG. 1A is for illustrative purposes. Although not shown, content distribution network 102 may also include other components of a content distribution network for a live streaming video service provider, such as

customer information servers, security devices, memory/storage devices, etc., and may manage the customer-provider relationship for many customers and user devices 140. Other configurations may be implemented. Therefore, network 100 may include additional, fewer, or different components than those depicted in FIG. 1A. Also, in some instances, one or more of the components of network 100 may perform one or more functions described as being performed by another one or more of the components of network 100.

User device 140 may include a device that is capable of receiving and playing streaming video content (e.g., a live video feed). For example, user device 140 may include a mobile device, such as a tablet, television (TV), personal computer (PC), video game console, or mobile telephone (e.g., a BlackBerry, Palm, Android, or iPhone operating system (iOS) handsets), etc. The streaming video content may include live video and/or audio content. User device 140 may be implemented in network 100 to receive the streaming video content from content distribution network 102. As described below, user device 140 may include a network optimization application that optimizes selection of a network to receive live streaming video based on an increasing order of preference from a mobile telecommunications network, such as a 3G or 4G network, a mobile wireless network (such as a Mi-Fi mobile hotspot) and a landline wireless network (such as a Wi-Fi network). In some implementations, user device 140 may also be capable of establishing a mobile wireless network that can be used by other user devices 140 to receive streaming video content from content distribution network 102.

Registration server 104 may provide registration services for user devices 140. Registration server 104 may generate a security protected webpage, such as a single sign-on (SSO) webpage, through which user device 140 may register with registration server 104 to receive streaming video content broadcast from content distribution network 102. Registration server 104 may support interaction with user device 140, providing registration and authentication services in conjunction with application server 120 and device server 108.

Application server 120 may support registration of user devices 140 and define network logic (e.g., rules for connecting user devices 140 to network 140) for user devices 140 that are to receive streaming video content from content distribution network 102. Application server 120 may define network logic for network 100 based on administrative input, network topology and/or business rules for content distribution network 102, such as a number of user devices 140 that may register or connect to a particular network in a region of network 100.

Device server 108 may control communication between user device 140 and content distribution network 102. For example, device server 108 may authenticate user devices 140 in conjunction with application server 120. In addition, device server 108, in conjunction with application server 120, may implement support for optimization of selection of a network to deliver streaming video content from content distribution network 102 to user device 140 as described below with respect to FIG. 1B.

Live content system 110 may broadcast a video feed. According to one embodiment, live content system 110 may include a capture card in a personal computer or a server that provides the video feed. The video feed may be a live streaming video feed and may be a digital or an analog video feed, depending on predetermined criteria, such as specifications of user device 140. The video feed may include videos from video conferencing applications, live video feeds, video

3

monitoring applications, sports programs, live performance event video programs, live video or television, etc.

Transcoding system **112** may convert the video feed from live content system **110** to a format that user device **140** may receive and display. Transcoding system **112** may transcode the video feed into a particular format based on specifications or information received from user device **140**, such as a type of operating system (e.g., iPhone format different from android format) or a particular application on user device **140** that may use the transcoded video content. For example, transcoding system **112** may transcode the video feed to a default format, such as H.264/MPEG4 Part 10 AVC (Moving Picture Experts Group Advanced Video Coding) at a bit rate of 256 kilobits per second (kbps).

Streaming server **114** may stream the transcoded video content to user devices **140** using a network selected by user device **140** and content distribution network **102**. Streaming server **114** may be Internet facing (e.g., streaming server **114** may include a port directly connected to the Internet) and may provide a streaming uniform resource locator (URL) to deliver the video content (i.e., the transcoded video feed is provided as streaming video content that may be accessed through the streaming URL) directly to mobile user devices **140**.

Streaming server **114** may provide the streaming URL to user device **140** based on a security protocol for network **100**. Streaming server **114** may provide the streaming URL to user device **140** after user device **140** has been authenticated, for instance, by application server **120** in conjunction with device server **108**, as described below.

Streaming server **114** may send a streaming URL associated with predetermined security features. For example, a streaming URL may be session based, i.e. each streaming URL may be used for a single session of video content streaming for user device **140**. In some implementations, streaming server **114** may send a token associated with the streaming URL. The token may be used to limit usage of the streaming URL to a specified time (i.e., the token may terminate the session at a predetermined time).

Content distribution network **102** may include a firewall **106** that protects devices in content distribution network **102**. For example, application server **120**, registration server **104**, live content system **110** and transcoding system **112** may be located behind firewall **106**. Firewall **106** may permit or deny transmissions to devices behind firewall **106**, for instance, transmissions from application server **120**, to other devices, such as device server **108**, based on security protocol and authorization procedures.

Network **130** may include one or more wired and/or wireless networks that are capable of receiving, carrying, and transmitting data, voice and/or video signals, including multimedia signals. Network **130** may include one or more 3G or 4G networks. Network **130** may also include one or more wireless/mobile networks and/or a public switched telephone network (PSTN). Network **130** may include one or more wireless networks established by user devices **140**. Further, network **130** may include one or more packet switched networks, such as an Internet protocol (IP) based network, a local area network (LAN), a wide area network (WAN), a personal area network (PAN), an intranet, the Internet, or another type of network that is capable of transmitting data. Network **130** may include one or more high-speed data networks, such as a very high performance backbone network services (vBNS) network.

FIG. 1B illustrates an exemplary functional block diagram of a network delivery management system **150**, which is a portion of content distribution network **102**. As shown, net-

4

work delivery management system **150** includes registration server **104**, application server **120**, and device server **108**. The configuration of components of network delivery management system **150** in FIG. 1B is for illustrative purposes. Other configurations may be implemented. Therefore, system **150** may include additional, fewer and/or different components than those depicted in FIG. 1B.

Network delivery management system **150** may provide meta data, authentication, etc., for user devices **140**. Network delivery management system **150** may also provide support for optimizing selection of a network to deliver streaming video to user device **140**.

Registration server **104** may register user device **140**, for instance, via a secure webpage. If user device **140** has been successfully registered with registration server **104**, registration server **104** may send a short message service (SMS) to user device **140** with instructions to download a streaming video application that supports optimized selection of a network for delivery of live streaming video. Registration server **104** may also send a separate email with a passcode (e.g., a passcode that includes 4-8 digits) to an email address, associated with user device **140**, which may be listed in an SSO database **154**. The passcode may be saved on user device **140** during installation of the streaming video application and may be accessed for authentication on each subsequent instance that user device **140** sends a request for streaming video to content distribution network **102**.

Application server **120** may support registration of user device **140** in conjunction with registration server **104**. Application server **120** may validate user device **140** using identifying information associated with user device **140** and information from a strong security user profile (SSUP) database (not shown). Application server **120** may publish user registration mobile device number (MDN)/pin to device server **108** for authentication during live broadcasting.

Application server **120** may receive administrative input and define network logic for network **100**, such as a number of user devices **140** that may register in network **100** (or particular regions of network **100**). Further, application server **120** may define predetermined number of user devices **140** that may connect to a mobile tower to avoid congestion, meet service level agreements (SLAs), reduce traffic jams etc.

Application server **120** may also store the locations of landline wireless networks (i.e., a location of a landline wireless device that generates a landline wireless network), mobile wireless networks (i.e., a location of a mobile wireless device that generates a mobile wireless network) and locations of user devices **140** in a database table, for example in locations database **152**. Location database **152** may also store other profile information such as device type, capability and video streams playing etc. This profile information may be obtained from the mobile networks or streaming servers or updated through device server **108** by mobile devices. For example, a mobile device may update a global positioning system (GPS) location associated with the mobile device and video streams from periodically. Application server **120** may use the updated GPS location to find the nearest mobile wireless device to provide a video stream for the mobile device using a mobile wireless network established by the mobile wireless device.

Application server **120** may access the stored locations when offloading streaming video content from mobile telecommunications networks to landline wireless networks and/or mobile wireless networks. Application server **120** may provide support for user device **140** to locate landline wireless networks and/or mobile wireless networks, in close proximity to user device **140**, over which user device **140** may receive streaming video from content distribution network **102**.

5

Application server 120 may provide locations of landline wireless networks and/or mobile wireless networks based on a location of user device 140.

Device server 108 may communicate (158) with user device 140. Device server 108 (in conjunction with registration server 104) may authenticate user device 140 based on information associated with user device 140, such as a mobile number or a passcode, for instance, received from an email sent by registration server 104 and saved on the handset during registration and application installation. Device server 108 may enforce network logic provided by application server 120. For example, authenticated user devices 140 may receive the video content via a streaming URL, which may be delivered through a secure hypertext transfer protocol secure (HTTPS) connection. User devices 140 that fail the authentication process may not receive the streaming URL.

As further shown in FIG. 1B, device server 108 may include a device location manager 156. Device location manager 156 may support location based functionalities for user device 140. Device location manager 156, in conjunction with application server 106, may locate landline wireless networks and/or mobile wireless networks in close proximity to requesting user device 140. A device may be in close proximity to a network if the device may connect to the network. Device location manager 156 may identify the closest of similar networks (e.g., a closest landline wireless network among multiple landline wireless networks selected based on, for instance, network signal strength) or all networks within close proximity of user device 140. User devices 140 may offload traffic (e.g., streaming video content) from mobile telecommunications networks to landline wireless networks and/or mobile wireless networks. Device location manager 156 may also determine correlations between motions of multiple user devices 140 and, in some implementations, motions of user devices 140 and mobile wireless networks. Device location manager 156 may determine correlations between motions of user devices 140 using tracking information, such as motion vectors associated with each device, cell tower information, etc.

FIGS. 2A and 2B illustrate functional block diagrams of user device 140 (FIG. 2A) and wireless network user device 200 (FIG. 2B). Wireless network user device 200 may be an implementation of user device 140 and as such functionality and features described with respect to user device 140 may be ascribed to wireless network user device 200. User devices 140 and wireless network user device 200 may each include a streaming application module 142, a network optimization module 144, and an operating system (OS) 146. Wireless network user device 200 also includes. However, wireless network user device 200 may also include a wireless network module 202 that is capable of generating a mobile wireless network 204. User device 140 and wireless network user device 200, in conjunction with provider network 102, may optimize selection of a delivery network for streaming video content. The configuration of components of user device 140 and wireless network user device 200 illustrated in FIGS. 2A and 2B is for illustrative purposes. Other configurations may be implemented. Therefore, user device 140 and wireless network user device 200 may include additional, fewer and/or different components than those depicted in FIGS. 2A and 2B.

According to one embodiment, user device 140 (and/or wireless network user device 200) may be a mobile telephone in which OS 146 is a mobile phone operating system, such as an Android operating system (OS), mobile Linux, BlackBerry OS, etc. According to another embodiment, user device

6

140 may be a computer (e.g. a desktop computer, personal computer, laptop computer, palmtop, or tablet computer). Each embodiment of user device 140 and wireless network user device 200 may include a graphical user interface (GUI) via which a user may select live video content.

Streaming application module 142 may support streaming video content from content distribution network 102 to user device 140, for instance, by performing registration, login, search, and streaming processes for user device 140. Streaming application module 142 may communicate with device server 108 and application server 120 to request and receive streaming video content.

According to one embodiment, streaming application module 142 may connect to device server 108 for authentication. Streaming application module 142 may provide information identifying user device 140 and device server 108, in conjunction with application server 120 and registration server 104, may perform an authentication process using the identifying information provided by streaming application module 142. Device server 108 may provide a streaming URL (if authentication of user device 140 is successful) or an error message (if authentication of user device 140 fails). In one implementation, user device 140 may communicate with device server 108 through an HTTPs connection.

Streaming application module 142 may receive the streaming URL and manage the streaming URL based on a predetermined security protocol. According to one embodiment, a streaming URL may be session based, and may be associated with a token attached to the streaming URL, that limits use of the streaming URL to a single instance. Streaming application module 142 may execute processes that reduce the probability that security associated with the streaming URL may be compromised (e.g., hijacked). Streaming application module 142 may also check with device server 108 at predetermined intervals to ensure that a session for the streaming URL has not expired. If the session for streaming URL has expired, streaming application module 142 may attempt to initiate a new session with content distribution network 102 through interaction with device server 108.

Network optimization module 144 may optimize selection of a network to deliver streaming video content (e.g., via the streaming URL). Network optimization module 144 may identify landline wireless networks, mobile wireless networks, or mobile telecommunications networks that may be used to deliver the streaming video content. User device 140 may be capable of optimizing selection of a network to receive live streaming video content and to play the live streaming video content. The optimized selection of a network to deliver the streaming video content to user device 140 may be transparent to a user of user device 140 (i.e., independent of the user and unapparent to the user) and may be performed by an application on user device 140 in conjunction with content distribution network 102.

Wireless network module 202 (FIG. 2B) may receive a streaming URL and stream the received URL to other user devices 140. In this instance, wireless network module 202 may communicate (158) with device server 108, to provide location information, to enable other user devices 140 and wireless network user devices 200 to use a mobile wireless network that wireless network module 202 generates (204) to receive the streaming video content (i.e., via the streaming URL).

Wireless network user device 200 may receive live streaming using mobile telecommunications network 302. User may view the streaming video content (e.g., on a display associated with wireless network user device 200) and wireless network user device 200 may concurrently stream the video

content to nearby user devices **140** and/or wireless network user devices **200**. Wireless network user device **200** may also report serving information for mobile wireless network **304** (e.g., Wi-Fi connection information such as SSID, authentication code, and streaming URL for nearby devices to receive the streaming video content) back to device server **108**.

FIGS. 3A and 3B illustrate conceptual implementations **300** and **350** associated with a process for optimizing selection of a network for delivering streaming video content to user device **140** from content distribution network **102**. Three types delivery networks are shown in increasing order of preference (or optimality) from left to right; a mobile telecommunications network (e.g., a 3G/4G network) **302** (a lowest preference network), a mobile wireless network (e.g. a Mi-Fi network) **304** (an intermediate preference network), and a landline wireless network **306** (a highest preference network). Landline wireless network **306** may be generated by a landline wireless device **312**. Although implementation **300** is described with respect to mobile telecommunications network **302**, mobile wireless network **304** and landline wireless network **306**, the concepts disclosed may be applied to optimized selection of a network among different types of networks to deliver streaming video content to user device **140**.

Device server **108** may monitor user device **140**, including a location of user device **140**. Application server **120** may store locations of mobile wireless networks **304** and landline wireless networks **306**, for example in a table that includes information describing locations and data regarding each mobile wireless network **304** and landline wireless network **306**.

Application server **120** may determine a landline wireless network (or networks) **306** that is in closest proximity to user device **140** based on the location of user device **140**, for instance, based on a location of a landline wireless device **312** that generates the landline wireless network **306**. Application server **120** may output location information for one or more landline wireless networks **306** to user device **140**. Similarly, application server **120** may determine mobile wireless networks **304** that are in close proximity to user device **140** and identify these prospective mobile wireless networks **304** to user device **140**.

FIG. 3A shows a conceptual implementation in which user device **140** is not in motion (i.e., user device **140** may be stationary or moving within proximity of landline wireless network **306**) and landline wireless network **306** is available. A delivery network is available if the delivery network signal is sufficient to support the streaming video content. Landline wireless network **306** may be a preferred delivery network for the streaming video content. Accordingly, user device **140** may receive the streaming video content directly from content distribution network **102** using landline wireless network **306**.

User device **140** may not have an established connection to a landline wireless network **306**. User device **140** may request information regarding landline wireless network **306** and streaming URL information from device server **108** if there is no established connection to a landline wireless network **306**. Device server **108** may identify a landline wireless network **306** in close proximity to user device **140** and return identifying and streaming information (e.g., a Wi-Fi service set identifier (SSID), authentication code and URL) to user device **140** to enable user device **140** to receive the streaming video content from landline wireless network **306**. User device **140** may connect to landline wireless network **306** and then use the URL to start streaming the video content from content distribution network **102**.

According to another implementation, there are no devices that support a landline wireless network **306** available in close proximity to user device **140**. In this instance, if there are also no devices that support a mobile wireless network **304** within close proximity, user device **140** may use mobile telecommunications network **302** to receive streaming video content.

However, if wireless network user device **200** or other devices that support a mobile wireless network **304** are within close proximity of user device **140** (e.g., wireless network user device **200** is within close proximity of devices that are to receive streaming video content), device server **108** may stream the video content to the device that supports a mobile wireless network **304**. Wireless network user device **200** may receive the streaming video content from content distribution network **102** through mobile telecommunications network **302** and stream the streaming video content to user device **140** using a mobile wireless network **304**.

User devices **140** and/or wireless network user devices **200** may query device server **108** to determine whether there are any landline wireless networks **306** and/or mobile wireless networks **304** available in close proximity that may deliver the streaming video content from content distribution network **102**. Device server **108** may check a database table (e.g., network locations database **152**) and determine that mobile wireless network **304** generated by wireless network user device **200** is in close proximity and is available for the requesting user devices **140** and/or wireless network user devices **200** (i.e., mobile wireless network **304** may support streaming video content for the requesting device).

Device server **108** may recommend (i.e., provide a recommendation message or other indication of the availability of mobile wireless network **304**) that other user devices **140** and/or wireless network user devices **200** connect to wireless network user device **200** through mobile wireless network **304** to receive the streaming video content. Device server **108** may provide network connection information to user devices **140** and/or wireless network user devices **200** (e.g., a Wi-Fi SSID, authentication code and URL for live streaming) based on authentication procedures between wireless network user device **200**, device server **108** and the requesting devices, such as user devices **140** and/or wireless network user devices **200**. User device **140** may connect to mobile wireless network **304** generated by wireless network user device **200** and begin to receive streaming video content from wireless network user device **200** (for instance output by wireless network module **202** (FIG. 2B)).

FIG. 3B shows a conceptual implementation in which multiple user devices **140** and/or wireless network user devices **200** are in motion. Device server **108** may have the locations of user devices **140** and/or wireless network user devices **200**. Device server **108** may detect a number and locations of user devices **140** and/or wireless network user devices **200** and determine whether the requesting devices are substantially moving in a same direction within close proximity to a mobile wireless network **304** generated by wireless network user device **200** (e.g., based on common vectors **320**, such as, in a train, plane or automobile). If there are multiple requesting devices moving in a same direction, device server **108** may use mobile wireless network **304** to offload wireless bandwidth consumption, i.e. wireless network user device **200a** may receive the live streaming through mobile telecommunications network **302** (e.g., a 3G or 4G network) and stream the video content through mobile wireless network **304** to nearby user devices **140** and/or wireless network user devices **200**. Device server **108** may direct wireless network device **200a** to provide the streaming video content to devices in close proximity using mobile wireless network **304**.

Wireless network user device **200a** may receive and display the live streaming video content from the mobile device and provide streaming video content through mobile wireless network **304**. Wireless network user device **200a** may report information that may enable other devices to receive the streaming video (e.g., Wi-Fi connection information such as SSID, authentication code, and URL for live streaming) back to device server **108** to be saved into an information table for network **100**.

User devices **140** and/or wireless network user devices **200** may query device server **108** to determine whether there are any landline wireless networks **306** and/or mobile wireless networks **304** available in close proximity that may deliver the streaming video content from content distribution network **102**. Device server **108** may check the database table and determine that wireless network user device **200a** is in close proximity and is available for the requesting user devices **140** and/or wireless network user devices **200**. Device server **108** may provide network connection information to other user devices **140** and/or wireless network user devices **200** (e.g., a Wi-Fi SSID, authentication code and URL for live streaming). User devices **140** may connect to mobile wireless network **304** generated by wireless network user device **200** and begin to receive streaming video content.

According to another implementation, user device **140** is moving alone. In this instance, user device **140** may be limited to receiving the live streaming video content through a mobile telecommunications network **302** or alternatively, connecting when possible to a landline wireless network **306** or a mobile wireless network **304**.

FIG. 4 is a diagram of exemplary components of a device **400**. User device **140**, wireless network user device **200**, registration server **104**, application server **120**, device server **108**, live content system **110**, transcoding system **112** or streaming server **114** may include one or more devices **400**. As shown in FIG. 4, device **400** may include a bus **410**, a processing unit **420**, a memory **430**, an input device **440**, an output device **450**, and a communication interface **460**.

Bus **410** may permit communication among the components of device **400**. Processing unit **420** may include any type of processor or microprocessor that interprets and executes instructions. In other implementations, processing unit **420** may be implemented as or include an application specific integrated circuit (ASIC), field programmable gate array (FPGA), or the like. Memory **430** may include a random access memory (RAM) or another type of dynamic storage device that stores information and instructions for execution by processing unit **420**, a read only memory (ROM) or another type of static storage device that stores static information and instructions for processing unit **420**, and/or some other type of magnetic or optical recording medium and its corresponding drive for storing information and/or instructions.

Input device **440** may include a device that permits an operator to input information to device **400**, such as a keyboard, a keypad, a mouse, a pen, a microphone, a remote, etc. Output device **450** may include a device that outputs information to the operator, such as a display, a speaker, etc.

Communication interface **460** may include a transceiver that enables device **400** to communicate with other devices or systems. Communication interface **460** may include a transmitter that converts baseband signals to radio frequency (RF) signals or a receiver that converts RF signals to baseband signals. Communication interface **460** may be coupled to an antenna for transmitting and receiving RF signals. Communication interface **460** may include a network interface card,

e.g., Ethernet card, for wired communications or a wireless network interface (e.g., a Wi-Fi) card for wireless communications.

In an exemplary implementation, device **400** may perform operations in response to processing unit **420** executing sequences of instructions contained in a computer-readable medium, such as memory **430**. A computer-readable medium may be defined as a physical or logical memory device. The software instructions may be read into memory **430** from another computer-readable medium (e.g., a hard disk drive (HDD), solid state drive (SSD), etc.), or from another device via communication interface **460**. Alternatively, hard-wired circuitry may be used in place of or in combination with software instructions to implement processes consistent with the implementations described herein. Thus, implementations described herein are not limited to any specific combination of hardware circuitry and software.

FIG. 5 is a flowchart of an exemplary process **500** for optimizing selection of a network to deliver streaming video content to a user device. Process **500** may execute in device server **108**. It should be apparent that the process discussed below with respect to FIG. 5 represents a generalized illustration and that other blocks may be added or existing blocks may be removed, modified or rearranged without departing from the scope of process **500**.

At block **502**, application server **120** may register and authenticate user device **140**. For example, application server **120** may communicate with user device **140** through device server **108**. Application server **120** may register and authenticate user device **140** in conjunction with device server **108** and registration server **104**, for instance as described above with respect to FIG. 1B and network delivery management system **150**.

At block **504**, application server **120** may receive a request for live streaming video content, for instance from user device **140**. For example, user device **140** may output a request for live streaming video to content distribution network **102** that may be received by device server **108** and routed to application server **120**.

At block **506**, application server **120** may identify a location of user device **140**. For example, application server **120** may identify the location of user device **140** based on location information provided by user device **140** and stored in network location database **152**.

At block **508**, application server **120** may identify available networks based on the location of user device **140**. For example, application server **120** may identify available networks within a predetermined proximity of user device **140**, or alternatively, determine a closet available network. Application server **120** may identify mobile telecommunications networks **302**, mobile wireless networks **304** and/or landline wireless networks **306** that may be used to provide streaming video content to user device **140**.

At block **510**, application server **120** (in conjunction with user device **140**) may optimize a selection of a network to deliver the streaming video content based on a location of user device **140** and available delivery networks in network **100**. The optimal network may be determined based on an increasing order of preference from a mobile telecommunications network **302** (a lowest preference network), a mobile wireless network **304** (an intermediate preference network) and a landline wireless network **306** (a highest preference network).

According to one embodiment, application server **120** may determine that a mobile wireless network **304** is to be selected to deliver streaming video content to user device **140** based on

11

the motion of user device **140** and a device that generates the mobile wireless network **304**, such as described with respect to FIG. 3B above.

At block **512**, content distribution network **102**, more particularly streaming server **114**, may provide live streaming video content to user device **140** using the optimal network determined by user device **140** in conjunction with device server **108** and application server **120**.

FIG. 6 is another flowchart of an exemplary process **600** for optimizing selection of a network to deliver streaming video content to a user device. Process **600** may execute in user device **140**. It should be apparent that the process discussed below with respect to FIG. 6 represents a generalized illustration and that other blocks may be added or existing blocks may be removed, modified or rearranged without departing from the scope of process **600**.

At block **602**, user device **140** may register with content distribution network **102**, for instance through device server **108** in conjunction with registration server **104**. User device **140** may also be authenticated with content distribution network **102** (e.g., by device server **108** in conjunction with registration server **104**).

At block **604**, user device **140** may request streaming video content, for example, from content distribution network **102**. For example, user device **140** may communicate with device server **108** to request the streaming video content based on input received through a GUI associated with user device **140**.

At block **606**, user device **140** may receive locations of available networks. For example, application server may determine one or more networks in close proximity to user device **140** that may be used to deliver streaming video content from content distribution network **102**. According to one embodiment, user device **140** may receive locations of mobile wireless networks **304** and landline wireless networks **306** in close proximity to user device **140**. Application server **120** may have a database table of all locations of mobile wireless networks **304** and landline wireless networks **306** in network **100**. Application server **120** in conjunction with user device **140** may use this information to determine a closest network for user device **140**.

At block **608**, user device **140** may identify an order of preference for networks through which streaming video content is to be delivered. For example, user device **140** may select an optimal network based on an increasing preference order of delivery networks.

At block **610**, user device **140** may select a network through which streaming video content is to be delivered based on the order of preference and the locations of available networks. For example, user device **140** may select a network based on an increasing preference order of deliver networks from mobile telecommunications networks, mobile wireless networks **302** and landline wireless networks **306**, which are in close proximity to user device **140**. User device **140** may select the delivery network based on a network type (e.g., a landline wireless network **306** as the highest order) and other differentiating criteria among networks of the same type, such as strength of signal, security features of the network bandwidth, etc.

At block **612**, user device **140** may receive streaming video content through the selected delivery network. For example, streaming server **114** may provide the streaming video content to user device **140** at a streaming URL.

Wireless network user device **200** may perform a process in a similar manner as described with respect to blocks **602-612** above. In the process, wireless network user device **200** may

12

generate mobile wireless network **304** and stream the video content to other user devices **140** and/or other wireless network user devices **200**.

The foregoing description of exemplary implementations provides illustration and description, but is not intended to be exhaustive or to limit the embodiments described herein to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of the embodiments. For example, while series of blocks have been described with respect to FIGS. 5 and 6 and content distribution network **102**, the order of the blocks may be modified in other implementations. Further, non-dependent blocks may be performed in parallel.

It will be apparent that different aspects of the description provided above may be implemented in many different forms of software, firmware, and hardware in the implementations illustrated in the figures. The actual software code or specialized control hardware used to implement these aspects is not limiting of the invention. Thus, the operation and behavior of these aspects were described without reference to the specific software code—it being understood that software and control hardware can be designed to implement these aspects based on the description herein.

Although the implementations described above mainly refer to a telecommunications service provider providing applications to a customer, in other implementations, other types of customer-provider relationships may be supported.

In the preceding specification, various preferred embodiments have been described with reference to the accompanying drawings. It will, however, be evident that various modifications and changes may be made thereto, and additional embodiments may be implemented, without departing from the broader scope of the invention as set forth in the claims that follow. The specification and drawings are accordingly to be regarded in an illustrative rather than restrictive sense.

No element, act, or instruction used in the description of the present application should be construed as critical or essential to the invention unless explicitly described as such. Also, as used herein, the article “a” is intended to include one or more items. Where only one item is intended, the term “one” or similar language is used. Further, the phrase “based on” is intended to mean “based, at least in part, on” unless explicitly stated otherwise.

What is claimed is:

1. A computer-implemented method comprising:

receiving a request to provide streaming video content from at least one user device, wherein the at least one user device includes a mobile device;

identifying a location of the at least one user device;

identifying, by the at least one user device, available networks to deliver the streaming video content based on the location of the at least one user device and locations of a device that generates one or more of the available networks;

identifying, by the at least one user device, network preference for delivery of the streaming video content, wherein the network preference is an increasing order of preference from a mobile telecommunications network, a mobile wireless network and a landline wireless network;

selecting an optimal network for delivering the streaming video content based on the location of the at least one user device, the available networks and the network preference for delivery of the streaming video content; and

providing the streaming video content using the optimal network.

13

2. The computer-implemented method of claim 1, wherein identifying available networks to deliver the streaming video content comprises:

determining whether the at least one user device is in motion; and

identifying the available networks based on one or more mobile telecommunications networks, mobile wireless networks and landline wireless networks in close proximity to the at least one user device in response to a determination that the at least one user device is not in motion.

3. The computer-implemented method of claim 1, wherein the at least one user device comprises a plurality of user devices including a wireless network user device capable of generating a mobile wireless network, further comprising:

determining whether a landline wireless network is available;

selecting the wireless network user device from among the plurality of user devices to receive the streaming video content in response to a determination that the landline wireless network is not available; and

directing the wireless network user device to generate the mobile wireless network, wherein the mobile wireless network is available for delivering the streaming video content to a remainder of the plurality of user devices.

4. The computer-implemented method of claim 1, wherein the at least one user device comprises a plurality of user devices including a wireless network user device capable of generating a mobile wireless network and wherein identifying available networks to deliver the streaming video content further comprises:

determining whether the plurality of user devices are in motion and in close proximity to each other;

determining whether the plurality of user devices are in motion in a substantially same direction in response to a determination that the plurality of user devices are in motion;

selecting the wireless network user device to receive the streaming video content in response to a determination that the plurality of user devices are in motion in a substantially same direction; and

directing the wireless network user device to generate the mobile wireless network, wherein the mobile wireless network is available for delivering the streaming video content to a remainder of the plurality of user devices.

5. The computer-implemented method of claim 1, wherein providing the streaming video content using the optimal network further comprises:

providing the streaming video content via a session based streaming uniform resource locator (URL).

6. The computer-implemented method of claim 1, wherein the streaming video content comprises live streaming video content.

7. The computer-implemented method of claim 1, wherein determining the available delivery networks for the streaming video content comprises:

identifying locations of one or more mobile wireless networks and landline wireless networks;

identifying the location of the at least one user device; and determining the available delivery networks based on close proximity of the identified locations of the one or more mobile wireless networks and landline wireless networks and the identified location of the at least one user device.

14

8. The computer-implemented method of claim 1, further comprising:

registering the at least one user device; and

authenticating the at least one user device.

9. The computer-implemented method of claim 1, further comprising:

defining network logic for the at least one user device to connect to a network based on one or more of administrative input, network topology and business rules.

10. The computer-implemented method of claim 1, further comprising:

updating a global positioning system (GPS) location associated with the at least one user device periodically.

11. A device, comprising:

a memory to store a plurality of instructions; and

a processor configured to execute instructions in the memory to:

receive a request to provide streaming video content from at least one user device;

identify a location of the at least one user device;

identify available networks to deliver the streaming video content based on the location of the at least one user device and a location of a device that generates one or more of the available networks;

identify network preference for delivery of the streaming video content, wherein the network preference is an increasing order of preference from a mobile telecommunications network, a mobile wireless network and a landline wireless network;

select an optimal network for delivering the streaming video content based on the location of the at least one user device, the available networks and the network preference for delivery of the streaming video content; and

provide the streaming video content using the optimal network.

12. The device of claim 11, wherein, when identifying available networks to deliver the streaming video content, the processor is further configured to:

determine whether the at least one user device is in motion; and

identify the available networks based on one or more mobile telecommunications networks, mobile wireless networks and landline wireless networks in close proximity to the at least one user device in response to a determination that the at least one user device is not in motion.

13. The device of claim 12, wherein the at least one user device comprises a plurality of user devices including a wireless network user device capable of generating a mobile wireless network and the processor is further configured to:

determine whether a landline wireless network is available;

select the wireless network user device to receive the streaming video content in response to a determination that the landline wireless network is not available; and direct the wireless network user device to generate the mobile wireless network, wherein the mobile wireless network is available for delivering the streaming video content to a remainder of the plurality of user devices.

14. The device of claim 11, wherein the at least one user device comprises a plurality of user devices including a wireless network user device capable of generating a mobile wireless network and wherein when identifying available networks to deliver the streaming video content, the processor is further configured to:

determine whether the plurality of user devices are in motion and in close proximity to each other;

**15**

determine whether the plurality of user devices are in motion in a substantially same direction in response to a determination that the plurality of user devices are in motion;

select the wireless network user device to receive the streaming video content in response to a determination that the plurality of user devices are in motion in a substantially same direction; and

direct the wireless network user device to generate the mobile wireless network, wherein the mobile wireless network is available for delivering the streaming video content to a remainder of the plurality of user devices.

**15.** The device of claim **11**, wherein when providing the streaming video content using the optimal network, the processor is further configured to:

provide the streaming video content via a session based streaming uniform resource locator (URL).

**16.** A non-transitory computer-readable medium including instructions to be executed by a processor, the instructions including one or more instructions, when executed by the processor, for causing the processor to:

receive a request to provide streaming video content from at least one user device, wherein the at least one user device includes a mobile device;

identify a location of the at least one user device;

identify available networks to deliver the streaming video content based on the location of the at least one user device and locations of a device that generates one or more of the available networks;

identify network preference for delivery of the streaming video content, wherein the network preference is an increasing order of preference from a mobile telecommunications network, a mobile wireless network and a landline wireless network;

select an optimal network for delivering the streaming video content based on the location of the at least one

**16**

user device, the available networks and the network preference for delivery of the streaming video content; and

provide the streaming video content using the optimal network.

**17.** The non-transitory computer-readable medium of claim **16**, wherein, when identifying the network preference for delivery of the streaming video content, the one or more instructions further includes instructions for causing the processor to:

update a global positioning system (GPS) location associated with the at least one user device periodically.

**18.** The non-transitory computer-readable medium of claim **16**, wherein, when identifying available networks to deliver the streaming video content, the one or more instructions further includes instructions for causing the processor to:

determine whether the at least one user device is in motion; and

identify the available networks based on one or more mobile telecommunications networks, mobile wireless networks and landline wireless networks in close proximity to the at least one user device in response to a determination that the at least one user device is not in motion.

**19.** The non-transitory computer-readable medium of claim **16**, wherein, when determining the available delivery networks for the streaming video content, the processor is further configured to:

identify locations of one or more mobile wireless networks and landline wireless networks;

identify the location of the at least one user device; and determine the available delivery networks based on close proximity of the identified locations of the one or more mobile wireless networks and landline wireless networks and the identified location of the at least one user device.

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